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Seaweeds Clean Long Island Sound

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Jang Kim, UConn assistant research professor, inspects a healthy kelp harvest utilizing the nutrients of Long Island Sound. Photo: C. Yarish

SEAWEEDS CLEAN LONG ISLAND SOUND

By Peg Van Patten

The Essential Services of Nutrient Bioextraction

Not everyone enjoys putting in the elbow grease for the annual spring cleaning at home, but it's an important task that most of us tackle. There's another type of cleaning happening right now that few people may be aware of, however. Long Island Sound waters are being cleaned, whether we are aware of it or not, by a process known as bioextraction.

Bioextraction is a fancy name for the practice of using biological means to remove something. In our case, it is the practice of removing nutrients, mainly nitrogen using the harvest of seaweed and shellfish production. Nutrients in the form of nitrogen compounds enter the Sound ecosystem via rivers, runoff, wastewater, and atmospheric discharge.

Historically, excess nitrogen has caused problems in the Sound by triggering phytoplankton and macroalgal blooms that, in the



Gracilaria being grown in Long Island Sound as an experiment.

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course of their dying and decay, lead to the depleted oxygen condition known as hypoxia. In that sense, nitrogen is a pollutant. However, nitrogen is also the most abundant gas in the air we breathe and part of the cells and DNA in our bodies. Without nitrogen, organisms could not form amino acids, which lead to proteins or even produce the building blocks of DNA. In aquatic ecosystems, nitrogen is literally too much of a good thing.

Enter seaweed. By simply growing, seaweed takes up nitrogen (where it may be a pollutant) by removing it from the water, and turns it into living tissue. That's what is known as an ecosystem service—improving conditions of the ecosystem for the benefit of living organisms and environment.

Charles Yarish, professor at the University of Connecticut Departments of Ecology and Evolutionary Biology, and Marine Sciences, has been a leader in developing this technology in the United States. He and colleagues Jang Kim (assistant research professor, UConn Marine Sciences) and George Kraemer (professor, SUNY Purchase) were curious about how much nitrogen could actually be removed by cultivating seaweed and harvesting it. Yarish and Kim were especially curious about how bioextraction could work in a heavily urbanized environment.

With support from Connecticut Sea Grant and the Long Island Sound Study, they set up three locations to grow seaweed for bioextraction. One site was in the waters off of Branford, Connecticut, one off of Fairfield, and the third in the Bronx River estuary, New York. Two native species were used; *Saccharina*



High School students at Bridgeport aquaculture high school and at Rocking the Boat in the Bronx have been part of the team involved in growing and harvesting kelp for nutrient extraction, improving water quality at Hunt's Point, NY and in Fairfield and Branford, CT.

latissima (sugar kelp) and *Gracilaria tikvahiae*, a bushy red alga. Kelp is a cold water crop, growing best from November to May, while *Gracilaria* is a warm water species growing from June to October, providing data for a year-round bioextraction study.

Basically, these seaweeds, which can be grown along with shellfish (or even finfish), take up nitrogenous compounds in animal waste products (yes, poop), wastewater, or nonpoint pollution (land-based fertilizer runoff in the form of ammonium or ammonia and even aerial deposition), and turn

it into healthy tissue, leaving the water cleaner. But how effective could this really be?

The researchers set out to quantify this question with real numbers, to answer the question of how valuable this service really is.

The results were impressive but not without challenges. In 2012, using a longline kelp farm placed off Fairfield in Long Island Sound, the researchers showed that a hypothetical 1-hectare kelp farm on longlines could remove 71 to 280

kilograms of nitrogen (equivalent to 156 to 617 pounds)—that's a lot of nitrogen. The following year was not as successful, being complicated by a January Nor'easter that slammed the experimental apparatus, resulting in lower amounts. Attempts to select the genetic kelp strains that are most efficient at removing nitrogen were thwarted as well, but not by Mother Nature—rather by human means. Someone vandalized the experiment by cutting off the long lines deployed to grow the kelp. Still, results show a lot of promise for this technology to gently improve the water quality of estuarine ecosystems.

Gracilaria, also an economically important seaweed species, was grown in the waters off of the Bronx, NY and in western Long Island Sound during the late summer months when eutrophication problems tend to occur. It was also successful at removing nitrogen.

At the Bronx site, *Gracilaria* grew over 16 percent per day and accumulated nitrogen up to 6 percent of its dry weight. In Long Island Sound, *Gracilaria* grew up to 11 percent per day with nitrogen accumulation in its tissue of up to 5 percent dry weight. In comparison, The sugar kelp accumulated nitrogen over 3 percent of its dry weight.

Using these measurements, Kim and Yarish estimated that if both species were grown in aquaculture operations, using just 1.5 percent of the Sound, 2.2 million kilograms (nearly 5.9 million pounds) could be removed per year. In addition, the seaweeds are effective at removing carbon dioxide, and together could remove about 2,000 kilograms of carbon per hectare (4400 pounds per acre) per year. The UConn School of Business developed an economic model that estimated the value at

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"Sea vegetables" is a more apt description for kelp than "seaweed" — and it can also be called a nutrient scrubber!



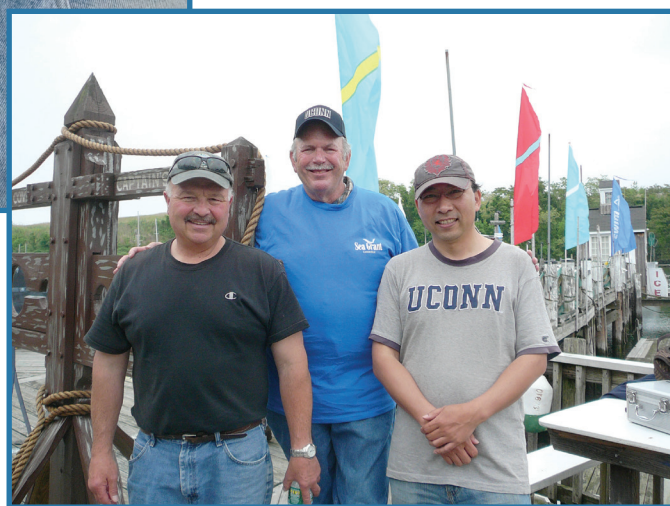
UConn's Charles Yarish (right) and Jang Kim (left) hold a spool with sugar kelp seedstring at The Thimble Island Oyster Company's seaweed farm in the Thimble Islands. The kelp farm (B. Smith, owner) was the first one in Long Island Sound.

ABOUT THE AUTHOR

Peg Van Patten is communications director for Connecticut Sea Grant and editor of *Wrack Lines* magazine.

about \$3000 per hectare (\$1200 per acre) for this service. Yarish and Kim received the Connecticut Quality Improvement Award (CQIA) Innovation Prize in June 2013 for their seaweed aquaculture and nutrient bioextraction research in Long Island Sound. This award is presented to honor advance innovative programs that improve quality performance and marketplace competitiveness.

So while you're wiping away pollen and winter grime from the windows or spraying your car chassis, wear a little contented smile because you know that uncomplaining seaweeds are steadily cleaning the Sound for you, bringing healthier waters all year round. As seaweed and multi-species aquaculture grows, water quality improves.



Captain Kenneth Tober (Bridgeport Regional Aquaculture Science & Technology Education Center; BRASTEC), with Yarish (center) and Kim (right). With Captain Tober, BRASTEC's students, teachers and staff have worked with UCONN to cultivate sugar kelp and the native red seaweed, *Gracilaria tikvahiae* at BRASTEC's lease site off Fairfield, CT.